



Learner's Guide

Renewable Energy

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Seminar: Renewable Energy

Background on the FEMP First Thursday Seminars

The **First Thursday Seminars** are designed for Federal Energy Managers but are open to anyone whose scope of responsibility involves influencing decisions to increase energy efficiency, conserve water resources, and meet other Federal sustainability goals.

There are three ways to participate in the seminars.

1. Live streaming video available on the day of the event over the internet to a desktop computer or via a projection system in a conference room;
2. Digital and Analog Satellite downlink technology for group showings; and,
3. Archived streaming video available after the event over the Internet on a desktop computer or via a projection system in a conference room.

To learn more about accessing specific seminars, access <http://www.femp.energy.gov/firstthursday>.

Introduction

The seminar **Renewable Energy** is being offered live on Thursday, May 5, 2011 at 1:30 pm Eastern Time.

For access and other course information, visit [the seminar's landing page](#). **Renewable Energy** will cover requirements and best practices for utilizing renewable energy for electricity, heating, cooling, and other applications at Federal facilities. The seminar will last 90 minutes.

Learner Objectives

After completing this seminar, the learner will be able to:

1. Discuss various types of renewable technologies – their benefits, uses, and limitations.
2. Discuss processes for considering renewable energy technologies for your site
3. Access various screening tools available from FEMP.
4. Discuss options for purchasing renewable energy.
5. Discuss three things to consider when planning renewable technology projects.

Asking Questions

At the end of the seminar, there will be an opportunity for you to ask questions. You will be able to email, fax, or ask questions by phone. You may email or fax your questions anytime during the broadcast. You will be able to speak “live” with the instructor at the end of the presentation. The phone, fax, and email information will be posted on the screen during the seminar.

During the live broadcast, ask questions by either:

- Dialing the toll free number 800-775-3728
- Faxing questions to 865-381-0554
- Or by sending an email to FTS@energyworkshops.org.

Upon Seminar Completion

Each participant who registers for the training via FEMP Central or who signs a Roster (at a satellite broadcast location) will be sent an email with a link to the seminar evaluation and the open book quiz. If you do not have a Roster, they are [available here](#). Please sign the Roster and scan/ email to ruleb@tds.net or Fax to 865-381-0554. Upon completion of the evaluation and the open book quiz, you will be able to print a course completion certificate for your records.

Additional Materials

The materials in this section support the learning in the presentation.

Resources for Your Use

Prior to attending this course, please spend 20 minutes reviewing the Department of Energy, Federal Energy Management Program (FEMP) website materials related to Renewable Energy at:
http://www1.eere.energy.gov/femp/technologies/renewable_energy.html.

Glossary of Terms

Alcohol Fuels: Alcohol can be blended with gasoline for use as transportation fuel. It may be produced from a wide variety of organic feedstock. The common alcohol fuels are methanol and ethanol. Methanol may be produced from coal, natural gas, wood and organic waste. Ethanol is commonly made from agricultural plants, primarily corn, containing sugar.

Alternating Current (AC): An electric current that reverses its direction at regularly recurring intervals, usually 50 or 60 times per second.

Amorphous Silicon: An alloy of silica and hydrogen, with a disordered, noncrystalline internal atomic arrangement, that can be deposited in thin-layers (a few micrometers in thickness) by a number of deposition methods to produce thin-film photovoltaic cells on glass, metal, or plastic substrates.

Annual Solar Savings: The annual solar savings of a solar building is the energy savings attributable to a solar feature relative to the energy requirements of a non-solar building.

Array Current: The electrical current produced by a photovoltaic array when it is exposed to sunlight.

Array Operating Voltage: The voltage produced by a photovoltaic array when exposed to sunlight and connected to a load.

Availability Factor: A percentage representing the number of hours a generating unit is available to produce power (regardless of the amount of power) in a given period, compared to the number of hours in the period.

Availability: The quality or condition of a photovoltaic system being available to provide power to a load. Usually measured in hours per year. One minus availability equals downtime.

Azimuth Angle: The angle between true south and the point on the horizon directly below the sun.

Balance of System: Represents all components and costs other than the photovoltaic modules/array. It includes design costs, land, site preparation, system installation, support structures, power conditioning, operation and maintenance costs, indirect storage, and related costs.

Bioenergy: Useful, renewable energy produced from organic matter, which may either be used directly as a fuel or processed into liquids and gases.

Biofuels: Liquid fuels and blending components produced from biomass (plant) feedstocks, used primarily for transportation.

Biomass gas (Biogas): A medium Btu gas containing methane and carbon dioxide, resulting from the action of microorganisms on organic materials such as a landfill.

Biomass: Energy from organic materials such as plants, agriculture residues, forestry residues, urban wood and waste,

and other by-products. Used to produce fuel, heat, or electricity. Organic non-fossil material of biological origin constituting a renewable energy source.

BIPV (Building-Integrated Photovoltaics): A term for the design and integration of photovoltaic (PV) technology into the building envelope, typically replacing conventional building materials. This integration may be in vertical facades, replacing view glass, spandrel glass, or other facade material; into semitransparent skylight systems; into roofing systems, replacing traditional roofing materials; into shading “eyebrows” over windows; or other building envelope systems.

Black Liquor (Pulping Liquor): The alkaline spent liquor removed from the digesters in the process of chemically pulping wood. After evaporation, the liquor is burned as a fuel in a recovery furnace that permits the recovery of certain basic chemicals.

Cogeneration: See combined heat and power.

Combined Collector: A photovoltaic device or module that provides useful heat energy in addition to electricity.

Combined Cycle: An electric generating technology in which electricity is produced from otherwise lost waste heat exiting from one or more gas (combustion) turbines. The exiting heat is routed to a conventional boiler or to a heat recovery steam generator for utilization by a steam turbine in the production of electricity. Such designs increase the efficiency of the electric generating unit.

Combined Heat and Power (CHP) Plant: A plant designed to produce both heat and electricity from a single heat source. Note: This term is being used in place of the term “cogenerator” that was used by EIA in the past.

Concentrator: A photovoltaic module, which includes optical components such as lenses (Fresnel lens) to direct and concentrate sunlight onto a solar cell of smaller area. Most concentrator arrays must directly face or track the sun. They can increase the power flux of sunlight hundreds of times.

Conventional hydroelectric (hydropower) plant: A plant in which all of the power is produced from natural streamflow as regulated by available storage.

Daylighting: the practice of placing windows or other openings and reflective surfaces so that during the day natural light provides effective internal lighting.

Days of Storage: The number of consecutive days the stand-alone system will meet a defined load without solar energy input. This term is related to system availability.

Design Month: The month having the combination of insolation and load that requires the maximum energy from the photovoltaic array.

Diffuse Insolation: Sunlight received indirectly as a result of scattering due to clouds, fog, haze, dust, or other obstructions in the atmosphere. Opposite of direct insolation.

Diffuse Radiation: Radiation received from the sun after reflection and scattering by the atmosphere.

Digester Gas: Biogas that is produced using a digester which is an airtight vessel or enclosure in which bacteria decomposes biomass in water to produce biogas.

Direct Insolation: Sunlight falling directly upon a collector. Opposite of diffuse insolation.

Distributed Energy Resources (DER): A variety of small, modular power-generating technologies that can be combined

with energy management and storage systems and used to improve the operation of the electricity delivery system, whether or not those technologies are connected to an electricity grid.

Distributed Generation (Distributed Energy Resources): Refers to electricity provided by small, modular power generators (typically ranging in capacity from a few kilowatts to 50 megawatts) located at or near customer demand.

Distributed Generation: A popular term for localized or on-site power generation.

Distributed Systems: Systems that are installed at or near the location where the electricity is used, as opposed to central systems that supply electricity to grids. A residential photovoltaic system is a distributed system.

Electric Utility: A corporation, person, agency, authority, or other legal entity or instrumentality aligned with distribution facilities for delivery of electric energy for use primarily by the public. Included are investor-owned electric utilities, municipal and State utilities, Federal electric utilities, and rural electric cooperatives. A few entities that are tariff based and corporately aligned with companies that own distribution facilities are also included.

Electrical grid: An integrated system of electricity distribution, usually covering a large area.

Emissions: Anthropogenic releases of gases to the atmosphere. In the context of global climate change, they consist of radiatively important greenhouse gases (e.g., the release of carbon dioxide during fuel combustion).

Energy Contribution Potential: Recombination occurring in the emitter region of a photovoltaic cell.

Energy Crops: Crops grown specifically for their fuel value. These include food crops such as corn and sugarcane, and nonfood crops such as poplar trees and switchgrass. Currently, two energy crops are under development: short-rotation woody crops, which are fast - growing hardwood trees harvested in five to eight years, and herbaceous energy crops, such as perennial grasses, which are harvested annually after taking two to three years to reach full productivity.

Ethanol: Ethanol is typically produced chemically from ethylene, or biologically from fermentation of various sugars from carbohydrates found in agricultural crops and cellulosic residues from crops or wood. The lower heating value, equal to 76,000 Btu per gallon, is assumed for estimates in this report.

Flat Plate Pumped: A medium-temperature solar thermal collector that typically consists of a metal frame, glazing, absorbers (usually metal), and insulation and that uses a pump liquid as the heat-transfer medium: predominant use is in water heating applications.

Fuel Cells: One or more cells capable of generating an electrical current by converting the chemical energy of a fuel directly into electrical energy. Fuel cells differ from conventional electrical cells in that the active materials such as fuel and oxygen are not contained within the cell but are supplied from outside.

Flat-Plate Photovoltaics (PV): A PV array or module that consists of nonconcentrating elements. Flat-plate arrays and modules use direct and diffuse sunlight, but if the array is fixed in position, some portion of the direct sunlight is lost because of oblique sun-angles in relation to the array.

Fuelwood: Wood and wood products, possibly including coppices, scrubs, branches, etc., bought or gathered, and used by direct combustion.

Full Sun: The amount of power density in sunlight received at the earth's surface at noon on a clear day (about 1,000 Watts/square meter).

Geothermal Energy: As used at electric power plants, hot water or steam extracted from geothermal reservoirs in the Earth's crust that is supplied to steam turbines at electric power plants that drive generators to produce electricity.

Geothermal Plant: A plant in which a turbine is driven either from hot water or by natural steam that derives its energy from heat found in rocks or fluids at various depths beneath the surface of the earth. The fluids are extracted by drilling and/or pumping.

Geothermal: Energy from heat and hot water found within the earth. Used to provide heat or electricity.

Gigawatt (GW): A unit of power equal to 1 billion Watts; 1 million kilowatts, or 1,000 megawatts.

Green Pricing/Marketing: In the case of renewable electricity, green pricing represents a market solution to the various problems associated with regulatory valuation of the nonmarket benefits of renewables. Green pricing programs allow electricity customers to express their willingness to pay for renewable energy development through direct payments on their monthly utility bills.

Grid: The layout of an electrical distribution system.

Grid-Connected System: A solar electric or photovoltaic (PV) system in which the PV array acts like a central generating plant, supplying power to the grid.

Gross Generation: The total amount of electric energy produced by the generating units at a generating station or stations, measured at the generator terminals.

Heat Pump (Geothermal): A heat pump in which the refrigerant exchanges heat (in a heat exchanger) with a fluid circulating through an earth connection medium (ground or ground water). The fluid is contained in a variety of loop (pipe) configurations depending on the temperature of the ground and the ground area available. Loops may be installed horizontally or vertically in the ground or submersed in a body of water.

High-Temperature Collector: A solar thermal collector designed to operate at a temperature of 180 degrees Fahrenheit or higher.

Hybrid System: A solar electric or photovoltaic system that includes other sources of electricity generation, such as wind or diesel generators.

Hydrokinetic: Run of the river.

Hydropower: Energy from water harnessed through the use of dams and hydrokinetic technology. Used for electricity.

Independent Power Producer (IPP): A corporation, person, agency, authority, or other legal entity or instrumentality that owns or operates facilities for the generation of electricity for use primarily by the public, and that is not an electric utility.

Internal Collector Storage (ICS): A solar thermal collector in which incident solar radiation is absorbed by the storage medium.

ISPRA Guidelines: Guidelines for the assessment of photovoltaic power plants, published by the Joint Research Centre of the Commission of the European Communities, Ispra, Italy.

Kilowatt (kW): One thousand watts of electricity (See Watt).

Kilowatthour (kWh): One thousand watthours.

Landfill Gas: Energy from methane and other landfill gases created during waste decomposition. Used to generate

heat and electricity. Gas that is generated by decomposition of organic material at landfill disposal sites. Landfill gas is approximately 50 percent methane.

Levelized Cost: The present value of the total cost of building and operating a generating plant over its economic life, converted to equal annual payments. Costs are levelized in real dollars (i.e., adjusted to remove the impact of inflation).

Limited Liability Corporation (LLC): A company that limits the liability of its participants to the assets they commit to the enterprise.

Liquid Collector: A medium-temperature solar thermal collector, employed predominantly in water heating, which uses pumped liquid as the heat-transfer medium.

Low-Temperature Collectors: Metallic or nonmetallic solar thermal collectors that generally operate at temperatures below 110 degrees Fahrenheit and use pumped liquid or air as the heat transfer medium. They usually contain no glazing and no insulation, and they are often made of plastic or rubber, although some are made of metal.

Medium-Temperature Collectors: Solar thermal collectors designed to operate in the temperature range of 140 degrees to 180 degrees Fahrenheit, but that can also operate at a temperature as low as 110 degrees Fahrenheit. The collector typically consists of a metal frame, metal absorption panels with integral flow channels (attached tubing for liquid collectors or integral ducting for air collectors), and glazing and insulation on the sides and back.

Megawatt (MW): One million watts of electricity (See Watt).

Methane: A colorless, flammable, odorless hydrocarbon gas (CH₄) which is the major component of natural gas. It is also an important source of hydrogen in various industrial processes. Methane is a greenhouse gas.

MSW (Municipal Solid Waste): Residential solid waste and some nonhazardous commercial, institutional, and industrial wastes.

Methyl Tertiary Butyl Ether (MTBE): A fuel oxygenate produced by reacting methanol with isobutylene.

Municipal or Industrial Waste: Energy from processing waste products found in municipal areas or industrial processes. Used to generate electricity.

Net Generation: Gross generation less the electric energy consumed at the generating station for station's use.

Net Metering: Arrangement that permits a facility (using a meter that reads inflows and outflows of electricity) to sell any excess power it generates over its load requirement back to the electrical grid to offset consumption.

Net Photovoltaic Cell Shipment: The difference between photovoltaic cell shipments and photovoltaic cell purchases.

Net Photovoltaic Module Shipment: The difference between photovoltaic module shipments and photovoltaic module purchases.

Net summer capacity: The maximum output, commonly expressed in megawatts (MW), that generating equipment can supply to system load, as demonstrated by a multi-hour test, at the time of summer peak demand (period of May 1 through October 31). This output reflects a reduction in capacity due to electricity use for station service or auxiliaries.

Nonutility Generation: Electric generation by nonutility power producers to supply electric power for industrial, commercial, and military operations, or sales to electric utilities. See Nonutility Power Producer.

Nonutility Power Producer: A corporation, person, agency, authority, or other legal entity or instrumentality that owns electric generating capacity and is not an electric utility. Nonutility power producers include qualifying cogenerators, qualifying small power producers, and other nonutility generators (including independent power producers) without a designated, franchised service area that do not file forms listed in the Code of Federal Regulations, Title 18, Part 141.

Ocean Energy: Energy from marine and tidal currents as well as temperature differences between ocean depths. Used for mechanical, thermal, or electrical energy.

Operation and Maintenance (O&M) Cost: Operating expenses are associated with operating a facility (i.e., supervising and engineering expenses). Maintenance expenses are that portion of expenses consisting of labor, materials, and other direct and indirect expenses incurred for preserving the operating efficiency or physical condition of utility plants that are used for power production, transmission, and distribution of energy.

Other Biomass: This category of biomass energy includes: agricultural by-products/crops (agricultural by-products, straw); other biomass gas (digester gas, methane); other biomass liquids (fish oil, liquid acetone, waste, tall oil, waste alcohol); other biomass solids (medical waste, solid by-products; sludge waste and tires).

Paper Pellets: Paper compressed and bound into uniform diameter pellets to be burned in a heating stove.

Parabolic Dish: A high-temperature (above 180 degrees Fahrenheit) solar thermal concentrator, generally bowl-shaped, with two-axis tracking.

Parabolic Trough: A high-temperature (above 180 degrees Fahrenheit) solar thermal concentrator with the capacity for tracking the sun using one axis of rotation.

Passive Solar: A system in which solar energy alone is used for the transfer of thermal energy. Pumps, blowers, or other heat transfer devices that use energy other than solar are not used.

Peak Power Current: Amperes produced by a photovoltaic module or array operating at the voltage of the I-V curve that will produce maximum power from the module.

Peak Watt: A manufacturer's unit indicating the amount of power a photovoltaic cell or module will produce at standard test conditions (normally 1,000 watts per square meter and 25 degrees Celsius).

Photovoltaic (PV) Array: An interconnected system of PV modules that function as a single electricity-producing unit. The modules are assembled as a discrete structure, with common support or mounting. In smaller systems, an array can consist of a single module.

Photovoltaic (PV) Cell: The smallest semiconductor element within a PV module to perform the immediate conversion of light into electrical energy (direct current voltage and current). Also called a solar cell.

Photovoltaic (PV) Cell: An electronic device consisting of layers of semiconductor materials fabricated to form a junction (adjacent layers of materials with different electronic characteristics) and electrical contacts and being capable of converting incident light directly into electricity (direct current).

Photovoltaic (PV) Module: An integrated assembly of interconnected photovoltaic cells designed to deliver a selected level of working voltage and current at its output terminals, packaged for protection against environment degradation, and suited for incorporation in photovoltaic power systems.

Photovoltaic (PV) Conversion Efficiency: The ratio of the electric power produced by a photovoltaic device to the power of the sunlight incident on the device.

Photovoltaic (PV) Device: A solid-state electrical device that converts light directly into direct current electricity of voltage-current characteristics that are a function of the characteristics of the light source and the materials in and design of the device. Solar photovoltaic devices are made of various semiconductor materials including silicon, cadmium sulfide, cadmium telluride, and gallium arsenide, and in single crystalline, multicrystalline, or amorphous forms.

Photovoltaic (PV) Effect: The phenomenon that occurs when photons, the “particles” in a beam of light, knock electrons loose from the atoms they strike. When this property of light is combined with the properties of semiconductors, electrons flow in one direction across a junction, setting up a voltage. With the addition of circuitry, current will flow and electric power will be available.

Photovoltaic (PV) Module: The smallest environmentally protected, essentially planar assembly of solar cells and ancillary parts, such as interconnections, terminals, [and protective devices such as diodes] intended to generate direct current power under unconcentrated sunlight. The structural (load carrying) member of a module can either be the top layer (superstrate) or the back layer (substrate).

Photovoltaic (PV) Panel: Often used interchangeably with PV module (especially in one-module systems), but more accurately used to refer to a physically connected collection of modules (i.e., a laminate string of modules used to achieve a required voltage and current).

Photovoltaic (PV) System: A complete set of components for converting sunlight into electricity by the photovoltaic process, including the array and balance of system components.

Photovoltaic(s) (PV): Pertaining to the direct conversion of light into electricity.

Photovoltaic-Thermal (PV/T) System: A photovoltaic system that, in addition to converting sunlight into electricity, collects the residual heat energy and delivers both heat and electricity in usable form. Also called a total energy system.

Process Heating: The direct process end use in which energy is used to raise the temperature of substances involved in the manufacturing process.

Production Tax Credit (PTC): An inflation - adjusted 1.5 cents per kilowatthour payment for electricity produced using qualifying renewable energy sources.

Public Utility Regulatory Policies Act of 1978 (PURPA): One part of the National Energy Act, PURPA contains measures designed to encourage the conservation of energy, more efficient use of resources, and equitable rates. Principal among these were suggested retail rate reforms and new incentives for production of electricity by cogenerators and users of renewable resources.

Pumped-storage hydroelectric plant: A plant that usually generates electric energy during peak load periods by using water previously pumped into an elevated storage reservoir during off-peak periods when excess generating capacity is available to do so. When additional generating capacity is needed, the water can be released from the reservoir through a conduit to turbine generators located in a power plant at a lower level.

Qualifying Facility (QF): A cogeneration or small power production facility that meets certain ownership, operating, and efficiency criteria established by the Federal Energy Regulatory Commission (FERC) pursuant to the Public Utility Regulatory Policies Act of 1978 (PURPA). (See the Code of Federal Regulations, Title 18, Part 292.)

Renewable energy: Electric energy generated from solar, wind, biomass, landfill gas, ocean (including tidal, wave, current, and thermal), geothermal, municipal solid waste, or new hydroelectric generation capacity achieved from increased efficiency or additions of new capacity at an existing hydroelectric project.

Renewable Energy Resources: Energy resources that are naturally replenishing but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy resources include: biomass, hydro, geothermal, solar, wind, ocean thermal, wave action, and tidal action.

Renewable Portfolio Standard (RPS): A mandate requiring that renewable energy provide a certain percentage of total energy generation or consumption.

Ribbon Silicon: Single-crystal silicon derived by means of fabricating processes that produce sheets or ribbons of single-crystal silicon. These processes include edge-defined film-fed growth, dendritic web growth, and ribbon-to-ribbon growth.

Roundwood: Wood cut specifically for use as a fuel.

Satellite Power System (SPS): Concept for providing large amounts of electricity for use on the Earth from one or more satellites in geosynchronous Earth orbit. A very large array of solar cells on each satellite would provide electricity, which would be converted to microwave energy and beamed to a receiving antenna on the ground. There, it would be reconverted into electricity and distributed the same as any other centrally generated power, through a grid.

Silicon: A semiconductor material made from silica, purified for photovoltaic applications.

Sludge: A dense, slushy, liquid-to-semifluid product that accumulates as an end result of an industrial or technological process designed to purify a substance. Industrial sludges are produced from the processing of energy-related raw materials, chemical products, water, mined ores, sewerage, and other natural and man-made products. Sludges can also form from natural processes, such as the run off produced by rain fall, and accumulate on the bottom of bogs, streams, lakes, and tidelands.

Solar Constant: The average amount of solar radiation that reaches the earth's upper atmosphere on a surface perpendicular to the sun's rays; equal to 1353 Watts per square meter or 492 Btu per square foot.

Solar Cooling: The use of solar thermal energy or solar electricity to power a cooling appliance. Photovoltaic systems can power evaporative coolers ("swamp" coolers), heat-pumps, and air conditioners.

Solar Energy: Electromagnetic energy transmitted from the sun (solar radiation). The amount that reaches the earth is equal to one billionth of total solar energy generated, or the equivalent of about 420 trillion kilowatt-hours.

Solar Resource: The amount of solar insolation a site receives, usually measured in kWh/m²/day, which is equivalent to the number of peak sun hours.

Solar Thermal Collector, Special: An evacuated tube collector or a concentrating (focusing) collector. Special collectors operate in the temperature (low concentration for pool heating) to several hundred degrees Fahrenheit (high concentration for air conditioning and specialized industrial processes).

Solar Thermal Collector: A device designed to receive solar radiation and convert it into thermal energy. Normally, a solar thermal collector includes a frame, glazing, and an absorber, together with the appropriate insulation. The heat collected by the solar thermal collector may be used immediately or stored for later use.

Solar: Energy from the sun processed by multiple technology options. Used directly for heating or for electricity generation.

Spent liquor: The liquid residue left after an industrial process; can be a component of waste materials used as fuel.

Spent Sulfite Liquor: End product of pulp and paper manufacturing processes that contains lignins and has a high moisture content; often re-used in recovery boilers. Similar to black liquor.

System Benefits Charge (SBC): A non-bypassable fee on transmission interconnection; funds are allocated among public purposes, including the development and demonstration of renewable energy technologies.

Thermophotovoltaic Cell (TPV): A device where sunlight concentrated onto a absorber heats it to a high temperature, and the thermal radiation emitted by the absorber is used as the energy source for a photovoltaic cell that is designed to maximize conversion efficiency at the wavelength of the thermal radiation.

Thermosiphon System: A solar collector system for water heating in which circulation of the collection fluid through the storage loop is provided solely by the temperature and density difference between the hot and cold fluids.

Thin-Film Silicon: A technology in which amorphous or polycrystalline material is used to make photovoltaic (PV) cells.

Transmission System (Electric): An interconnected group of electric transmission lines and associated equipment for moving or transferring electric energy in bulk between points of supply and points at which it is transformed for delivery over the distribution system lines to consumers, or is delivered to other electric systems.

Useful Thermal Output: The thermal energy made available for use in any industrial or commercial process or used in any heating or cooling application, i.e., total thermal energy made available for processes and applications other than electrical generation.

Watt (Electric): The electrical unit of power. The rate of energy transfer equivalent to 1 ampere of electric current flowing under a pressure of 1 volt at unity power factor.

Watt (Thermal): A unit of power in the metric system, expressed in terms of energy per second, equal to the work done at a rate of 1 joule per second.

Watthour (Wh): The electrical energy unit of measure equal to 1 watt of power supplied to, or taken from, an electric circuit steadily for 1 hour.

Wind energy: Energy present in wind motion that can be converted to mechanical energy for driving pumps, mills, and electric power generators. Wind pushes against sails, vanes, or blades radiating from a central rotating shaft.

Wind power plant: A group of wind turbines interconnected to a common utility system through a system of transformers, distribution lines, and (usually) one substation. Operation, control, and maintenance functions are often centralized through a network of computerized monitoring systems, supplemented by visual inspection. This is a term commonly used in the United States. In Europe, it is called a generating station.

Wind: Energy from the wind harnessed through turbines and windmills. Used for mechanical power and electricity.

Wood energy: Wood and wood products used as fuel, including round wood (cord wood), limb wood, wood chips, bark, sawdust, forest residues, charcoal, pulp waste, and spent pulping liquor.

Wood pellets: Sawdust compressed into uniform diameter pellets to be burned in a heating stove.

Wood/Wood Waste: This category of biomass energy includes: black liquor; wood/wood waste liquids (red liquor, sludge wood, spent sulfite liquor); wood/wood waste solids (peat, paper pellets, railroad ties, utility poles, wood/wood waste).